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### REMARKS

The amendment to the specification contains a few typographical errors and improves the wording of the specification. Support for the inclusion of Fe in the paragraph on page 5 is found in original claim 1.

Support for the "one or more deformation and annealing cycles" in the amended paragraph on page 23 is also found in original claim 1.

Support for the lower annealing temperature of 100°C in claim 1 is found on page 10, line 24. Support for the revised language of step "a)" in claim 1 and the corresponding portions of claims 12, 13, 24 and 25, is found on page 8, lines 9-10 and page 8, lines 19-20, wherein it is specified that the deformation step is carried out below the solvus temperature of the metal without requiring a minimum temperature.

The revisions to claims 2, 9 and 10 are supported in the specification on page 5, lines 24-30 and page 7, lines 12-16.

The revisions to claims 4 and 5 are supported in the specification on page 7, line 9 which specifically refers to the process being applied to straps and posts. In addition, it is stated on page 7 that the invention is applicable to "other metallic articles employed in electrochemical cells" (page 7, lines 12-16). It is also stated on page 7 that an objective of the invention is to improve corrosion properties of metallic parts used in electrochemical cells (page 7, lines 24-26). Such parts are specifically identified as connectors which include straps, lugs and posts (see page 1, lines 31-33).

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Support for new claims 15-39 is as follows:

claim 15; page 9, lines 16-18  
claim 16; page 8, lines 20-21  
claim 17; page 9, line 18;  
claims 18-20; page 8, line 31  
claim 21; page 10, lines 4-17  
claim 22; page 10, line 13  
claim 23; page 18, lines 20-24  
claim 24; page 19, lines 8-13  
claim 25; page 19, lines 15-20  
claim 26; page 20, lines 6-9  
claim 27; page 21, lines 9-19  
claim 28; page 21, lines 9-10 and lines 21-26  
claim 29; page 21, lines 9-10 and lines 28-33  
claim 30; page 22, lines 27-34  
claims 31-39; original claims 3-11.

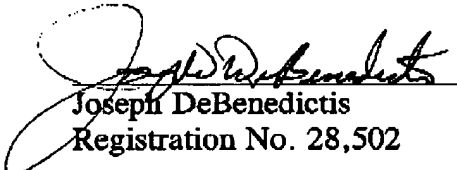
Respectfully submitted,

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**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

**IN THE SPECIFICATION:**

The paragraph on page 5, beginning at line 24 and ending on page 5, line 30, was amended as follows:

It is an object of this invention to provide a method for making current collectors from lead and lead-alloyed with at least one element selected from the group of Ag, Al, As, Ba, Bi, Ca, Cd, Cu, Fe, Li, Mg, Na, Se, Sb, Sn, Sr, and Zn utilizing gravity or continuous casting; casting a billet followed by extrusion and/or rolling, and, if desired suitably perforating the strip e.g. by expansion or punching. In its final form the current collector can be a bookmold grid, a tubular grid, a foil or sheet, a perforated strip, i.e. suitably punched or expanded, a continuous cast grid or a continuous cast grid which is subsequently rolled to its final dimension.

The paragraph on page 19, beginning at line 22 and ending on page 19, line 24, was amended as follows:

The treatment time varies, depending on the material, but typically ranges from 1 [seconds] second to three days, more typically from 5 seconds to 12 hours, and preferably from 10 seconds to 3 hours.

The paragraph on page 20, beginning at line 19, and ending on page 20, line 30, was amended as follows:

To measure the samples resistance to strain deformation, which is directly related to positive current collector growth in a lead-acid battery, standard ASTM E139

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creep tests were performed. Each sample was subjected to a [strain] stress of 4.8 MPa over a period of several hours at room temperature. The amount of deformation, in millimetres, was then plotted as a function of time. The results are summarised in Figure 3. The rate of strain deformation over time for the as cast material was calculated as 1150% per year. By comparison, the rate of strain deformation for the grain boundary engineered material was found to be only 35% per year. The grain boundary engineered material processed by the embodiments of the present invention showed greatly increased resistance to strain deformation. It should be noted that this result cannot be attributed to precipitation effects as outlined in the work of Tilman and Myers as the commercially pure lead does not contain any precipitate forming elements, and further underscores the novelty of this present invention.

The paragraph on page 23, beginning with the term "Example #4" at line 17 and ending on page 23, line 30 was amended as follows:

#### EXAMPLE #4

Various lead alloys were subjected to [the] one or more deformation and annealing [cycle] cycles used to make the recrystallized lead-alloy according to this invention. [Each of the samples] In each cycle the sample was deformed at room temperature to 25% reduction in thickness and then annealed by heat-treating at 255°C for five minutes. After the first deformation reduction and annealing, each of the aforementioned lead alloys was tested for hardness. A minimum of six hardness measurements at each of two locations of the test alloys were obtained using a Shimadzu model HMV2000 micro hardness tester utilizing a 25g load. The hardness of each metal was also measured in the same way in the as-cast condition (i.e. without being subjected to deformation and annealing cycle). The  $f_p$  count of the as-cast material samples prior to GBE processing in all cases was between 10 and 15%. The

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results of the hardness test for each of the lead alloys is shown in Table 2. In all instances, the deformation reduction and heat annealing [cycle] cycle(s) resulted in an alloy having a lower hardness than the one of the corresponding as-cast alloy.

The paragraph on page 29, beginning with the term "Example #10" at line 5 and ending on page 29, line 14, was amended as follows:

#### EXAMPLE #10

A set of Pb-Ca-Sn-alloy bookmould cast grids was surface peened at room temperature for 10 seconds, followed by heat treatment (275 °C, 10 minutes). Careful analysis of grid cross sections revealed that the penetration depth achieved extended up to 350 micron below the peened surface and that the grain size in the near surface layer was 10 micron, while it remained at about 260 micron in the bulk material. The surface layer of the peened and annealed sample had a  $f_{sp}$  of 40%, whereas the untreated sample  $f_{sp}$  and the  $f_{sp}$  of the treated material more than 350 microns below the surface remained at 15 % (table 8).

[ $f_{sp}$ ]

Please replace the paragraph on page 30, beginning with the term "Example #11" at line 9 and ending on page 30, line 17, with the following rewritten paragraph:

#### EXAMPLE #11:

Two Pb-Ca-Sn alloys were cast into sheets. An as received set representing prior art and a set processed according to the invention were corrosion tested in an environment representative of a zinc-electrowinning operation. The peening was performed using 28 mil steel shot at 80 psi at room temperature. Three passes per substrate were performed within three minutes and the peened samples were

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subsequently annealed at 250 °C for 10 minutes. A pretreatment comprising a 30 minute soak at 300 °C was used to modify existing precipitates to facilitate the GBE process. The following table 9 illustrates the sample characteristics and the corrosion performance.

IN THE CLAIMS:

Please amend claim 1 as follows:

1. (Amended) Recrystallized lead or lead alloy formed by recrystallizing a mass of lead or lead alloy to produce a percentage of special grain boundaries which is at least 20% of the total grain boundaries of said lead or lead alloy; said recrystallization being effected by subjecting said mass of lead or lead alloy to at least one cycle having the sequential steps of:

a) deforming at least a portion of said mass of lead or lead alloy while maintaining said mass at a temperature [which is above room temperature] up to the solvus temperature of said lead or lead alloy, and optionally quenching said mass;

b) annealing said mass of lead or lead alloy at a temperature between [150°C] 100°C and the melting point of said lead or lead alloy for a time sufficient to effect recrystallization of said lead or lead alloy; and

c) optionally repeating steps a) and b);

said lead alloy being lead alloyed with at least one element selected from the group consisting of Ag, Al, As, Ba, Bi, Ca, Cd, Cu, Fe, Li, Mg, Na, Se, Sb, Sn, Sr, and Zn.

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2. (Amended) The recrystallized lead or lead alloy of claim 1 wherein said mass of lead or lead alloy which is subjected to said at least one cycle is [in the form of a solid strip obtained by casting or extruding said lead or lead alloy.] a current collector in the form of a bookmold grid, a tubular grid, a foil, a sheet, a perforated strip, a continuous cast grid, a continuous cast grid rolled to its final dimensions, a connector or a non consumable electrode for use in an electrochemical cell.

3. (Amended) The recrystallized lead or lead alloy of claim 2 wherein said deforming takes place by rolling, expanding, punching, bending or peening said solid [strip] mass of lead or lead alloy.

4. (Amended) The recrystallized lead or lead alloy of claim 3 which is in the form of a positive current collector, or a strap, lug or post for use in a lead-acid battery.

5. (Amended) The recrystallized lead or lead alloy of claim 4 wherein said solid [strip] mass has a thickness equal to or greater than the desired thickness of said positive current collector, strap, lug or post.

8. (Amended) The recrystallized lead or lead alloy of claim 7 wherein said temperature range is 40°C [-] to 95°C.

9. (Amended) The recrystallized lead or lead alloy of claim 3 wherein said [strip] current collector in the form of a foil, a sheet, a continuous cast grid, a continuous cast grid rolled to its final dimensions or non consumable electrode for use in an electrochemical cell, is deformed by rolling, bending or peening.

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10. (Amended) The recrystallized lead or lead alloy of claim [9] 3 wherein said [strip] current collector in the form of a bookmold grid, a tubular grid, a foil, a sheet, a perforated strip, a continuous cast grid, a continuous cast grid rolled to its final dimensions, a connector or a non consumable electrode for use in an electrochemical cells is deformed by peening.

11. (Amended) The recrystallized lead or lead alloy of claim 3 wherein said [strip] mass is perforated.

12. (Amended) Recrystallized lead or lead alloy formed by recrystallizing a cast billet of lead or lead alloy to produce a percentage of special grain boundaries which is at least 40% of the total grain boundaries of said lead or lead alloy; said recrystallization being effected by subjecting said billet to at least one cycle having the sequential steps of:

a) extruding said billet to a strip of desired thickness while maintaining the strip at a temperature [which is above room temperature] up to the solvus temperature of said lead or lead alloy, optionally quenching the strip;

b) optionally deforming the strip by rolling, expanding, punching, bending or peening to a desired thickness while maintaining the strip at a temperature [which is above room temperature] up to the solvus temperature of said lead or lead alloy, optionally quenching the strip;

c) annealing the lead or lead alloy strip at a temperature between 150°C and the melting point of the alloy for a time sufficient to effect recrystallization of the lead or lead alloy;

said lead alloy being lead alloyed with at least one element selected from the group consisting of Ag, Sn, Cu, Zn, As, Bi, Li, Na, Al, Mg, Ca, Sr, Ba, Cd, Fe, Se, and Sb.



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13. (Amended) A method for reducing intergranular degradation of lead or lead alloy which comprises recrystallizing said lead or lead alloy to produce a percentage of special grain boundaries which is at least 20% of the total grain boundaries of said lead or lead alloy; said recrystallization being effected by subjecting said lead or lead alloy to at least one cycle having the sequential steps of:

a) deforming at least a portion of a mass of said lead or lead alloy while maintaining said mass at a temperature [which is above room temperature] up to the solvus temperature of said lead or lead alloy, optionally quenching said mass;

b) annealing said mass of lead or lead alloy at a temperature between 150°C and the melting point of said alloy for a time sufficient to effect recrystallization of said lead or lead alloy;

c) optionally repeating steps a) and b);

said alloy being lead alloyed with at least one element selected from the group consisting of Ag, Al, As, Ba, Bi, Ca, Cd, Cu, Fe, Li, Mg, Na, Se, Sb, Sn, Sr, and Zn.